

PATENT COOPERATION TREATY

PCT

From the INTERNATIONAL BUREAU

NOTIFICATION CONCERNING
SUBMISSION OR TRANSMITTAL
OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

To:

KOLSTER OY AB
Iso Roobertinkatu 23
P.O. Box 148
FIN-00121 Helsinki
FINLANDE

Date of mailing (day/month/year) 19 April 2000 (19.04.00)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference 2980494PC/nu	
International application No. PCT/FI99/00821	International filing date (day/month/year) 05 October 1999 (05.10.99)
International publication date (day/month/year) 13 April 2000 (13.04.00)	Priority date (day/month/year) 06 October 1998 (06.10.98)
Applicant NOKIA NETWORKS OY et al	

1. The applicant is hereby notified of the date of receipt (except where the letters "NR" appear in the right-hand column) by the International Bureau of the priority document(s) relating to the earlier application(s) indicated below. Unless otherwise indicated by an asterisk appearing next to a date of receipt, or by the letters "NR", in the right-hand column, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).
2. This updates and replaces any previously issued notification concerning submission or transmittal of priority documents.
3. An asterisk(*) appearing next to a date of receipt, in the right-hand column, denotes a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b). In such a case, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.
4. The letters "NR" appearing in the right-hand column denote a priority document which was not received by the International Bureau or which the applicant did not request the receiving Office to prepare and transmit to the International Bureau, as provided by Rule 17.1(a) or (b), respectively. In such a case, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

<u>Priority date</u>	<u>Priority application No.</u>	<u>Country or regional Office or PCT receiving Office</u>	<u>Date of receipt of priority document</u>
06 Octo 1998 (06.10.98)	982167	FI	05 Octo 1999 (05.10.99)

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. (41-22) 740.14.35	Authorized officer Marie-José Devillard Telephone No. (41-22) 338.83.38
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PATENT COOPERATION TREATY

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NOTIFICATION CONCERNING
DOCUMENT TRANSMITTED

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents
United States Patent and Trademark
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ETATS-UNIS D'AMERIQUE

in its capacity as designated Office

Date of mailing (day/month/year)

19 April 2000 (19.04.00)

International application No.

PCT/FI99/00821

International filing date (day/month/year)

05 October 1999 (05.10.99)

Applicant

NOKIA NETWORKS OY et al

The International Bureau transmits herewith the following documents and number thereof:

_____ cop(ies) of priority document(s) (Rule 17.2(a))

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Facsimile No.: (41-22) 740.14.35

Authorized officer

Marie-José Devillard

Telephone No.: (41-22) 338.83.38

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NOTIFICATION OF ELECTION

(PCT Rule 61.2)

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Date of mailing (day/month/year) 24 May 2000 (24.05.00)	Applicant's or agent's file reference 2980494PC/nu
International application No. PCT/FI99/00821	Priority date (day/month/year) 06 October 1998 (06.10.98)
International filing date (day/month/year) 05 October 1999 (05.10.99)	
Applicant RINNE, Mikko, J	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:
 26 April 2000 (26.04.00)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer R. E. Stoffel Telephone No.: (41-22) 338.83.38
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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

PCT

(PCT Article 36 and Rule 70)

15

Applicant's or agent's file reference 2980494PC/nu	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/FI99/00821	International filing date (day/month/year) 05.10.1999	Priority date (day/month/year) 06.10.1998
International Patent Classification (IPC) or national classification and IPC ₇ H04L 12/56, H04L 29/08, H04Q 7/22		
Applicant Nokia Networks OY, et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 3 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 26.04.2000	Date of completion of this report 01.02.2001
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. 08-667 72 88	Authorized officer Elisabet Åselius/JAN Telephone No. 08-782 25 00

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/FI99/00821

I. Basis of the report

1. With regard to the elements of the international application:*

- ☐ the international application as originally filed
- ☒ the description:
 pages 1-8, as originally filed
 pages _____, filed with the demand
 pages _____, filed with the letter of _____
- ☒ the claims:
 pages _____, as originally filed
 pages _____, as amended (together with any statement) under article 19
 pages _____, filed with the demand
 pages 1-3, filed with the letter of 19.01.2001
- ☒ the drawings:
 pages 1-2, as originally filed
 pages _____, filed with the demand
 pages _____, filed with the letter of _____
- ☐ the sequence listing part of the description:
 pages _____, as originally filed
 pages _____, filed with the demand
 pages _____, filed with the letter of _____

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language _____ which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheet/fig _____

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2 (c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

** Any replacement sheet containing such amendments must be referred to under item I and annexed to this report.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**1. Statement**

Novelty (N)	Claims	<u>1-14</u>	YES
	Claims		NO
Inventive step (IS)	Claims	<u>1-14</u>	YES
	Claims		NO
Industrial applicability (IA)	Claims	<u>1-14</u>	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

The claimed invention discloses a method for signalling extra information regarding segmented higher layer data units.

A higher layer data unit is split into smaller segments on a lower layer. The transmitting end must indicate to the receiving end, whether the same higher layer unit will continue in the next lower layer unit or a new higher level will be started in the next lower layer unit, so the receiver can assemble the segmented data. So far an extra field with a separate indicator has been used to specify if the higher layer unit starts, ends or continues in the present data segment. This causes extra overhead, which leads to a loss in performance.

The invention minimises this segmentation related loss by segmenting the higher layer data units into smaller lower layer units, each comprising one or more data segments, which each contain data from a different one of the upper layer data units. Lower layer data units, which contain two or more segments, are provided with segmentation length information. Predetermined values of this information indicate special information (i. e. whether a higher layer data unit stops, starts or continues in the lower layer segment, or if said segment contains padding). The special values of the length indicators are utilised in cases where the lower layer unit would otherwise contain padding. Therefore in most cases no extra overhead is needed and no loss of functionality is caused.

Documents cited in the International Search Report:

D1: WO 9738550
D2: US 5570362
D3: US 5583859
D4: EP 0786919
D5: US 5333135
D6: US 5737332

.../...

Supplemental Box

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: BOX V

D2 shows a system for transferring variable length cells under ATM. This document describes the segmenting of higher layer data units into smaller lower layer units, the transmission of the lower layer units followed by re-assembly at the receiving end (abstract, claims 8 & 12). Segmentation length information is provided (col.5, line 31-36; claim 2). It is also indicated that a rest of a lower layer data unit contains padding, if a payload is not filled with effective data. The boundary between effective data and padding is indicated (col.6, line 47-50, line 64-67; claims 4 and 5).

D3 reveals a data labelling technique for high performance protocol testing.

D4 deals with a data processing method for efficiently transporting multimedia packets over a packet switching network.

D5 is about identifying packets in a data stream.

D6 deals with a data link control method, where identification of segments is discussed.

D1 is about minicell segmentation and re-assembly. The document reveals the segmenting of larger data units of a higher layer into smaller units of a lower layer so that each lower layer unit comprises one or more data segments from a different one of the upper layer data units (claim 1; p.10 line 29-p.11 line 8). Lower layer data units are provided with segmentation length information (claim 5, p.10 line 8-12). Predetermined values of this information indicates special information of the higher level data unit (claims 5 & 6). The lower level data units are transmitted to a receiving end, where they are assembled by means of the segmentation length information (claims 8, 11 & 12).

D1 differs from the claimed invention however, by the fact that the capability to indicate first, middle or last segment is configured at the expense of the precision of the length indication. In addition the middle segment indication has to be sent repeatedly, in each segment, when sending a long higher layer data unit, which causes overhead avoided in the claimed invention.

Consequently the invention defined in claims 1-14 is novel, is considered to involve an inventive step and to have industrial applicability.

RECORD COPY

1/4

2980494PC/nu

PCT REQUEST

Original (for SUBMISSION) - printed on 05.10.1999 01:05:09 PM

0 0-1	For receiving Office use only International Application No.	PCT/FI 9 9 / 0 0 8 2 1
0-2	International Filing Date	0 5 OCT 1999 (0 5. 10. 99)
0-3	Name of receiving Office and "PCT International Application"	The Finnish Patent Office PCT International Application
0-4 0-4-1	Form - PCT/RO/101 PCT Request Prepared using	PCT-EASY Version 2.84 (updated 01.07.1999)
0-5	Petition The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	Receiving Office (specified by the applicant)	National Board of Patents and Registration (Finland) (RO/FI)
0-7	Applicant's or agent's file reference	2980494PC/nu
I	Title of invention	A DATA SEGMENTATION METHOD IN A TELECOMMUNICATIONS SYSTEM
II II-1 II-2 II-4 II-5	Applicant This person is: Applicant for Name Address:	applicant only all designated States except US NOKIA NETWORKS OY Keilalahdentie 4 FIN-02150 Espoo Finland
II-6	State of nationality	FI
II-7	State of residence	FI
III-1 III-1-1 III-1-2 III-1-4 III-1-5	Applicant and/or inventor This person is: Applicant for Name (LAST, First) Address:	applicant and inventor US only RINNE, Mikko J Tallbergin puistotie 1 C 25 FIN-00200 Helsinki Finland
III-1-6	State of nationality	FI
III-1-7	State of residence	FI

PCT REQUEST

2980494PC/nu

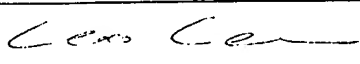
Original (for SUBMISSION) - printed on 05.10.1999 01:05:09 PM

IV-1	Agent or common representative; or address for correspondence The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:	agent
IV-1-1	Name	KOLSTER OY AB
IV-1-2	Address:	Iso Roobertinkatu 23 P.O. Box 148 FIN-00121 Helsinki Finland
IV-1-3	Telephone No.	358 9 618 821
IV-1-4	Facsimile No.	358 9 602 244
IV-1-5	e-mail	kolster@kolster.fi
V	Designation of States	
V-1	Regional Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	AP: GH GM KE LS MW SD SL SZ UG ZW and any other State which is a Contracting State of the Harare Protocol and of the PCT EA: AM AZ BY KG KZ MD RU TJ TM and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT EP: AT BE CH&LI CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE and any other State which is a Contracting State of the European Patent Convention and of the PCT OA: BF BJ CF CG CI CM GA GN GW ML MR NE SN TD TG and any other State which is a member State of OAPI and a Contracting State of the PCT
V-2	National Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	AE AL AM AT (patent and utility model) AU AZ BA BB BG BR BY CA CH&LI CN CR CU CZ (patent and utility model) DE (patent and utility model) DK (patent and utility model) DM EE (patent and utility model) ES FI (patent and utility model) GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MD MG MK MN MW MX NO NZ PL PT RO RU SD SE SG SI SK (patent and utility model) SL TJ TM TR TT TZ UA UG US UZ VN YU ZA ZW

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V-5	Precautionary Designation Statement In addition to the designations made under items V-1, V-2 and V-3, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except any designation(s) of the State(s) indicated under item V-6 below. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit.	
V-6	Exclusion(s) from precautionary designations	NONE
VI-1	Priority claim of earlier national application	
VI-1-1	Filing date	06 October 1998 (06.10.1998)
VI-1-2	Number	982167
VI-1-3	Country	FI
VI-2	Priority document request The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) identified above as item(s):	VI-1
VII-1	International Searching Authority Chosen	Swedish Patent Office (ISA/SE)
VIII	Check list	number of sheets electronic file(s) attached
VIII-1	Request	4 -
VIII-2	Description	8 -
VIII-3	Claims	3 -
VIII-4	Abstract	1 2980494p.txt
VIII-5	Drawings	2 -
VIII-7	TOTAL	18
VIII-8	Accompanying items	paper document(s) attached electronic file(s) attached
VIII-16	Fee calculation sheet	✓ -
VIII-16	PCT-EASY diskette	- diskette
VIII-17	Other (specified):	Copy of Official Action -
VIII-18	Figure of the drawings which should accompany the abstract	4A-4C
VIII-19	Language of filing of the international application	English
IX-1	Signature of applicant or agent	 Leo Lehtonen
IX-1-1	Name	KOLSTER OY AB

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10-1	Date of actual receipt of the purported international application	05 OCT 1999 (05 -10- 1999)
10-2	Drawings:	
10-2-1	Received	
10-2-2	Not received	

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10-3	Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application	
10-4	Date of timely receipt of the required corrections under PCT Article 11(2)	
10-5	International Searching Authority	ISA/SE
10-6	Transmittal of search copy delayed until search fee is paid	

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11-1	Date of receipt of the record copy by the International Bureau	
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09/806947

08 Rec'd PCT/PTO 06 APR 2001

APPLICATION UNDER UNITED STATES PATENT LAWS

Atty. Dkt. No. PW 278096/2980494US/A/HER
(M#)

Invention: A DATA SEGMENTATION METHOD IN A TELECOMMUNICATIONS SYSTEM

Inventor (s): RINNE, Mikko J.

Pillsbury Winthrop LLP
Intellectual Property Group
1100 New York Avenue, NW
Ninth Floor
Washington, DC 20005-3918
Attorneys
Telephone: (202) 861-3000

This is a:

- ☐ Provisional Application
- ☐ Regular Utility Application
- ☐ Continuing Application
☒ The contents of the parent are incorporated by reference
- ☒ PCT National Phase Application
- ☐ Design Application
- ☐ Reissue Application
- ☐ Plant Application
- ☐ Substitute Specification
Sub. Spec Filed _____
in App. No. _____ / _____
- ☐ Marked up Specification re
Sub. Spec. filed _____
In App. No. _____ / _____

SPECIFICATION

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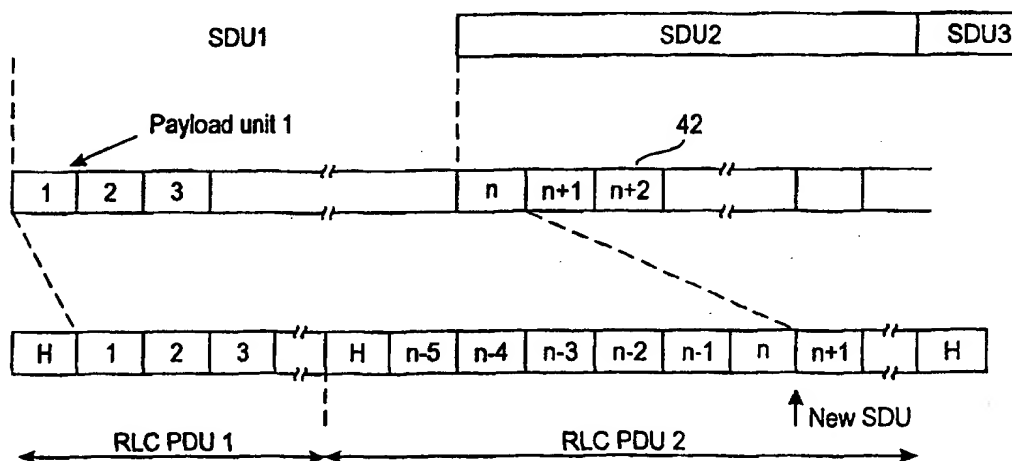
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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁷ : H04L 12/56, 29/08, H04Q 11/04, 7/22		A1	(11) International Publication Number: WO 00/21253
			(43) International Publication Date: 13 April 2000 (13.04.00)
(21) International Application Number: PCT/FI99/00821		(81) Designated States: AE, AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), DM, EE, EE (Utility model), ES, FI, FI (Utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).	
(22) International Filing Date: 5 October 1999 (05.10.99)			
(30) Priority Data: 982167 6 October 1998 (06.10.98) FI			
(71) Applicant (for all designated States except US): NOKIA NETWORKS OY [FI/FI]; Keilalahdentie 4, FIN-02150 Espoo (FI).			
(72) Inventor; and (75) Inventor/Applicant (for US only): RINNE, Mikko, J [FI/FI]; Tallbergin puistotie 1 C 25, FIN-00200 Helsinki (FI).			
(74) Agent: KOLSTER OY AB; Iso Roobertinkatu 23, P.O. Box 148, FIN-00121 Helsinki (FI).		Published With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.	

(54) Title: A DATA SEGMENTATION METHOD IN A TELECOMMUNICATIONS SYSTEM



(57) Abstract

In a telecommunications system a larger higher layer data unit (SDU) is segmented into smaller segments on the lower layer (RLC). A segmentation length information is used to indicate the lengths of the segments in a lower layer protocol data unit (PDU). Specific values of segmentation length information are employed to indicate, when necessary, special information about the upper layer data unit (SDU), such as whether the upper layer data unit ends in the current data segment in the lower layer PDU or continues to the next lower layer PDU. This information is needed in the receiver to correctly assemble the segmented data.

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Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

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EE	Estonia						

A data segmentation method in a telecommunications system

Field of the Invention

The invention relates to data segmentation in a data transmission or
5 signalling in telecommunications systems, and particularly in wireless telecommunications systems.

Background of the Invention

Wireless communications system refers generally to any telecommunications system which enable a wireless communication between the users and the network. In mobile communications systems users are capable of moving within the service area of the system. A typical mobile communications system is a Public Land Mobile Network (PLMN).

At present third generation mobile systems, such as Universal Mobile Communication System (UMTS) and Future Public Land Mobile Telecommunication System (FPLMTS) later renamed as IMT-2000 (International Mobile Telecommunication 2000), are being developed. The UMTS is being standardized in ETSI (European Telecommunication Standards Institute) whereas ITU (International Telecommunication Union) is defining the IMT-2000 system. The radio interface is likely to be based on a wideband CDMA (code division multiple access), and therefore the third generation systems are often referred to as Wideband CDMA systems (WCDMA). These future systems are basically very much alike.

Fig. 1 shows a simplified UMTS architecture with the external reference points and interfaces to the UMTS Terrestrial Radio Access Network, UTRAN. The UTRAN consists of a set of Radio Access Networks RAN (also called Radio Network Subsystem RNS) connected to the Core Network CN through the interface Iu. These Radio Network Subsystems can be interconnected through the interconnection point (reference point) Iur. The interfaces Iu(s) and Iur are logical interfaces. Iur can be conveyed over physical direct connection between RANs or via any suitable transport network. Each RAN is responsible for the resources of its set of cells. For each connection between a mobile station MS and the UTRAN, one RAN is the Serving RAN. A RAN consists of a Radio Network Controller RNC and a multiplicity of base stations BS.
35 The RNC is responsible for the handover decisions that require signalling to the MS. The base stations are connected to the RNC through the Iub inter-

face. The core network CN is a conventional or future telecommunication network modified to efficiently utilize the UTRAN in a wireless communication. Telecommunication networks that are thought to be suitable core networks are second generation mobile communication systems (PSTN), such as GSM, 5 ISDN (Integrated Services Digital Network), B-ISDN (Broadband ISDN), PDN (Packet Data Network), ATM etc.

Fig. 2 gives an overview of the assumed protocol environment in the third generation systems. Categorically, we can find three layers of the ISO/OSI layer model (International Standards Organisation/Open Systems 10 Interconnection): physical layer (Layer 1, L1), data link layer (Layer 2, L2), and network layer (Layer 3, L3). In Fig. 2 the Layer L3 includes Radio Resources Control (RRC) protocol and upper user plane protocols. RRC takes care of all radio resources management. It negotiates quality of service QoS for a bearer 15 service and on the basis thereof chooses needed transport format(s), (bitrates, type of coding, physical layer multiplexing), performs allocations (codes etc.), allocates identifiers for MS:s and bearer services, signals all of these parameters to MS, and supervises all handovers. User plane protocols relate to any upper layer transmission and signalling protocols. As used herein the term L3 20 protocols may also include the Link Access Protocol LAC set up between the MS and the core network CN although LAC may also be said to be an L2 protocol. LAN provides a peer-to-peer transportation of user data.

Layer L2 functions include the Radio Link Control (RLC) protocol and the Medium Access Control MAC. The RLC provides a radio-solution-dependent reliable link over the radio path. It takes care of segmentation and 25 assembly of the Layer 3 data before and after transmission over the radio path, respectively, as well as retransmissions. Under the RLC the MAC function controls the mapping of the RLC protocol data units (RLC PDUs) into physical channels in the physical layer. The physical layer includes all the schemes and mechanisms used to make communications possible on the radio 30 channel. These mechanisms include, for example, modulation, power control, coding and timing.

The RLC is capable of segmenting the higher layer PDUs. The segmenting allows a larger higher layer (e.g. L3, LAC) data unit to be split into smaller units (segments) on the lower layer (RLC). When segmenting is used, 35 the transmitting end should indicate to the receiving end whether the same higher layer unit will continue in the next lower layer unit or a new higher level

unit one will be started in the next lower layer unit. This information is needed in the receiver (either the mobile station (MS) or the network (NW)) to correctly assemble the segmented data.

5 In a prior art approach, a separate indicator has been used in each lower layer data segment to specify, whether the higher layer unit starts, ends or continues in the present data segment. Possible values may be the following, for example: 11 start & end; 10 start & continue; 00 continue; and 01 continue to end. The disadvantage of the prior art approach is that this extra field uses extra space in the protocol signalling and thereby causes extra overhead.

10

Disclosure of the Invention

An object of the present invention is a segmentation method in which the overhead and other loss of performance caused by the segmentation information is minimized.

15 A first aspect of the invention is a data segmentation method in a telecommunications system, comprising the steps of

segmenting larger data units of a higher layer into smaller protocol data units (PDU) of a lower layer so that each lower layer PDU comprises one or more data segments each containing data from a different one of the upper layer data units,

20 providing the lower layer protocol data units containing two or more data segments, with a segmentation length information which indicates the length of the data segments,

indicating with predetermined values of the segmentation length information special information about the higher level PDU,

25 transmitting the lower level PDUs to a receiving end, assembling the segmented higher level data unit at the receiving end by means of the segmentation length information.

A second aspect of the invention is a telecommunications system, comprising

30 an upper protocol layer comprising data units, a lower protocol layer comprising protocol data units having a payload size smaller than said upper layer data units,

means segmenting said upper layer data units for insertion into smaller protocol data units of a lower layer so that each lower layer PDU comprises one or more data segments each containing data from a different one of

35

the upper layer data units,

means for inserting a segmentation length information which indicates the length of the data segments at least in the lower layer PDUs containing two or more data segments,

5 means for giving a predetermined value in the segmentation length information in order to provide a receiver with special information about the higher level data unit,

means for assembling the segmented higher level data unit from received lower layer PDUs at the receiver by means of the segmentation length
10 information in said PDUs.

In the present invention specific values of segmentation length information are employed to indicate, when necessary, special information about the upper layer data unit, such as whether the upper layer data unit ends in the current data segment in the lower layer PDU or continues to the next lower
15 layer PDU. Thus, a separate indicator field used in the prior art is avoided.

Brief Description of the Drawings

In the following the invention will be described in greater detail by means of the preferred embodiments with reference to the accompanying
20 drawings, in which

Figure 1 shows a simplified UMTS architecture,

Figure 2 illustrates an example of the protocol structure which may be used in the UMTS system,

Figure 3 illustrates the structure of the RLC protocol data unit
25 (PDU),

Figures 4A, 4B and 4C illustrate the splitting of the upper layer service data unit (SDU) into payload units (PU) and the packing of the PUs in the RLC PDUs, and

Figure 5 illustrates a PU format with segmentation length indicators.
30

Preferred Embodiments of the Invention

The preferred embodiments of the invention are in the following described as implemented in the UMTS system. The invention is applicable to be used in any telecommunication system requiring segmentation of larger upper
35 protocol layer data units into smaller units on a lower protocol layer.

As used herein the term segmentation means splitting a larger data

unit of the higher layer (e.g. L3, LAC) into smaller units (segments) which can be accommodated by the lower layer (RLC) protocol data units (PDU). As a consequence, a data field of a lower layer PDU may contain one segment of an higher layer data unit, or two or more segments each containing data from a different one of the upper layer data units or padding. Segmentation information in a lower layer PDU is needed when the current upper layer data unit ends and a new upper layer data unit starts or padding is needed in the lower level PDU. The segmentation information is information included in the lower layer protocol unit in order to indicate to the receiving end how this segmentation, if any, in the PDU is done.

Examples of the architecture and the simplified protocol structure of a UMTS access network were described above with reference to Figs. 1 and 2, respectively.

The RLC can operate in assured, unassured and transparent modes. In the transparent mode no overhead is added to the data and no upper layer segmentation is maintained. In the assured and unassured modes segmentation and assembly of the upper layer PDUs is maintained. In the assured mode selective retransmission ARQ is also utilized to correct errors.

In the assured mode the RLC PDU has a control header and a data part consisting of one or more payload units (PU), as shown in Fig.3. The PU is the smallest unit of a retransmission protocol used between the transmitting end and the receiving end for error correction. The retransmission is based on an acknowledgement of PUs and/or sending retransmission requests for missing or distorted PUs by the receiving end. The size of the PU is constant, radio bearer specific, and it is determined in the L3 bearer setup negotiation. The size of the PU can be changed only through an L3 bearer reconfiguration. Several PUs are utilized for high data rates if also low data rates need to be served or if a tight raster of bit rates is required.

The normal control header includes a 14-bit sequence number (SN) of the first payload unit in the PDU and two 1-bit extension flags, E and D. If the extension flag E is set, an extended header is used, i.e. the next two octets contain a new sequence number SN with a new extension flags E and D. The second extension flag D is used to indicate that the PU referenced by the respective sequence number start with segmentation information. The SN field indicates the sequence number of a payload unit PU in the RLC PDU. In normal assured-mode RLC PDU header it is the sequence number of the first PU

in the PDU. If the PUs are not in sequence, a sequence number may be indicated separately for each PU by using the extended header. Also if some other than the first PU contains the segmentation information, the sequence number of the respective PU(s) is indicated separately by using the extended header.

5 If only the first PU in the RLC PDU contains the segmentation information the extension flag D in octet 2 of the PDU header is set (the first SN refers to the first PU). If several PUs contain the segmentation information in the PDU, each such PU is indicated in the PDU header by means of the respective PU sequence number with the D flag set. If no PU in the RLC PDU
10 contains the segmentation information, no D flag is set in the PDU header.

Figs. 4A and 4B illustrate how the upper layer (e.g. L3, LAC) data unit 41, called service data unit SDU herein, is split into smaller units 42, i.e. payload units PU. The border between two consecutive SDUs may be aligned
15 with a border between two consecutive PUs, as shown in Fig. 4B, or it may occur in the middle of PU. The PUs 42 are then packed into RLC PDUs, as illustrated in Fig. 4C. In accordance with the terminology used herein, RLC PDU1 in Fig. 4C contains only one data segment, i.e. each of the n PUs contain data only from one upper layer data unit, namely SDU1. However, the
20 RLC PDU2 in Fig. 4C contains two data segments, i.e. PUs n-5...n contain data from the SDU1 and thereby provides the first data segment, whereas PUs from n+1 forwards contain data from the SDU2 and thereby provides the second data segment.

The segmentation information is provided by a variable number of
25 length indicators that are included in at least one PU when needed. Length indicator is a (e.g. 7-bit) value the primary purpose of which is to indicate the length of the data segment in terms of octets (8 bits). However, all PUs in an RLC-U PDU do not need to have segmentation fields. The length indicator, for example 7-bit field, is assumed to be able to address all segments across the
30 whole RLC PDU and therefore length indicators are normally included only in the first PU of an RLC PDU. This due to the fact that the maximum size of an RLC-U PDU data segment (approx. 40 octets) is expected to be much less than the maximum number addressable by the length indicator (128 octets). Also, it is mandatory that the length of the PDU and PU are known to both the
35 transmitter and the receiver. The PU length is known from L3 service parameters and the RLC PDU length is recognized by receiving Layer 1 entity.

Fig. 5 illustrates a PU format with N length indicators in the first PU. The total number of segments is O, each being M octets in length. The flag E in the length indicator indicates whether there is another length indicator in the following octet (flag E = 1) or not (flag E = 0).

5 In the most simple case, where the PU contains data only from one SDU, and no segmentation information is needed in the PU. In other words, a PU without any segmentation information means that the PU is contiguous, comes from one SDU and the same SDU continues until the next PU which contains a segmentation information. No separate indicator for indicating
10 whether the SDU continues or not is needed. If all PUs in the RLC PDU contains data from the same SDU, no segmentation information is needed in the PDU. Alternatively, the first PU in the PDU may be provided with a length indicator having a predefined value which indicates that the SDU in this PDU continues in the next RLC PDU. Such a value may be 1111110, for example. If
15 the SDU ends at end of the current PDU, this indicated by a length indicator value which points exactly to the end of the PDU.

 In the second situation the current SDU does not fill the PU completely and data from the next SDU is inserted into the remaining space in the PU. The first PU is provided with a length indicator giving the number of octets
20 which contain data from the current SDU, i.e. the length indicator indirectly points the octet where the current segment and SDU ends. The flag E associated with the first length indicator is also set 1 to indicate that there is another length indicator. If the new SDU continues to the next PDU, a specific value, such as 11111110, is used for the second length indicator to indicate this. If
25 the new SDU ends at end of the current PDU, this indicated by a length indicator value which points exactly to the end of the PDU.

 In the third case the current SDU ends in the PDU and, since there is not more SDUs in the transmitter buffer, the rest of the PDU or part of it contains padding (fill bits). Again, the first PU is provided with a length indicator giving the number of octets which contain data from the current SDU, i.e.
30 the length indicator indirectly points the octet where the current SDU ends. The flag E associated with the first length indicator is also set 1 to indicate that there is another length indicator. The second length indicator is provided with a specific value, such as 1111111, to indicate that there is padding until the
35 next length indicator occurs (in the same or next PDU).

By using and interpreting some specific values of the length indicator according to the above rules, for example, no separate indicator for noting whether the SDU continues or not is needed.

5 An alternative way for the use of specific values of the length indicator for noting continuation or end of the SDU, might be to use one bit in the length indicator for that purpose. This approach would have a disadvantage, however. When a segmentation length indicator is used, the length of the longest possible data segment depends greatly on the number of bits that can be accommodated in one length indicator. From implementation point of view,
10 it is desirable to maintain octet alignment, and therefore the size of the length indicator is limited by the number of extra information that needs to be accommodated in the same octet. With 7 bits, a segment of 128 octets can be addressed, as noted. If one bit is stolen to the end-indication purposes, only 64 octets can be addressed with the remaining 6 bits. By using specific values
15 of the length indicator as described above also this disadvantage will be avoided.

The application has above been described by means of the preferred embodiments to illustrate the principles of the invention. Regarding the details the invention may vary within the scope and spirit of the accompanying
20 claims.

Claims

1. A data segmentation method in a telecommunications system, **characterized** by the steps of

5 segmenting larger data units of a higher layer into smaller protocol data units (PDU) of a lower layer so that each lower layer PDU comprises one or more data segments each containing data from a different one of the upper layer data units,

10 providing the lower layer protocol data units containing two or more data segments, with segmentation length information which indicates the length of the data segments,

indicating with predetermined values of the segmentation length information special information about the higher level PDU,

transmitting the lower level PDUs to a receiving end,

15 assembling the segmented higher level data unit at the receiving end by means of the segmentation length information.

2. The method as claimed in claim 1, **characterized** by said special information including indication whether the higher layer data unit ends in the current data segment or continues to the next lower level PDU

20 3. The method as claimed in claim 1 or 2, **characterized** by the step of

indicating with a predetermined value of the segmentation length information that the rest of the lower level PDU contains padding until the next segmentation length information or to the next lower level PDU.

25 4. The method as claimed in claim 1, 2 or 3, **characterized** by the step of

indicating with the segmentation length information pointing exactly to the end of the lower layer PDU that the higher layer data unit ends.

30 5. The method as claimed in claim 1, 2, 3 or 4, **characterized** by the step of

indicating with a predetermined value of the segmentation length information that the higher layer data unit carried in the current data segment continues to the next lower level PDU.

35 6. The method as claimed in any one of claims 1-5, **characterized** by the step of

providing no segmentation information in a lower layer PDU which contains data only from a single one of the higher layer data units and contain

no padding.

7. The method as claimed in any one of claims 1-6, **characterized** by the step of

5 providing segmentation information in a lower layer PDU which contains data only from a single one of the higher layer data units and padding.

8. The method as claimed in any one of claims 1-7, **characterized** by the steps of

10 providing each lower level PDU with two or more payload units of a predetermined length, the payload unit being the smallest unit in a retransmission protocol employed,

carrying said segmented higher layer data units in said payload units,

15 providing a segmentation indicator field in the beginning of one or more of the payload units in the lower level PDU, if required,

indicating in the header of the lower layer PDU which one or ones, if any, of the payload units contain the segmentation length information.

9. The method as claimed in any of claims 1-8, **characterized** by the step of

20 providing a segmentation indicator field in the beginning of the first one of the payload units for indicating segmentation information for all segments in the lower level PDU, if required.

10. A telecommunications system, **characterized** by
25 an upper protocol layer (L3, RRC;LAC) comprising data units (SDU),

a lower protocol layer (L2, RLC) comprising protocol data unit (PDU) having a payload size smaller than said upper layer data units (SDU),

30 means segmenting said upper layer data units (SDU) for insertion into smaller protocol data units (PDU) of a lower layer so that each lower layer PDU comprises one or more data segments each containing data from a different one of the upper layer data units (SDU),

means for inserting a segmentation length information (LI) which indicates the length of the data segments at least in the lower layer PDUs containing two or more data segments,

35 means for giving a predetermined value in the segmentation length information (LI) in order to provide a receiver with special information about the

higher level data unit (SDU),

means for assembling the segmented higher level data unit (SDU) from received lower layer PDUs at the receiver by means of the segmentation length information in said PDUs.

5 11. The system as claimed in claim 10, **characterized** by a predetermined value of the segmentation length information (LI) indicating to the receiver that the rest of the lower level PDU contains padding until the next segmentation length information or to the next lower level PDU.

10 12. The system as claimed in claim 10 or 11, **characterized** by a predetermined value of the segmentation length information (LI) indicating to the receiver that the higher layer data unit (SDU) carried in the current data segment continues to the next lower level PDU.

15 13. The system as claimed in claim 10, 11 or 12, **characterized** by segmentation length information (LI) pointing exactly to the end of the lower layer PDU being defined to the receiver that the higher layer data unit (SDU) ends.

 14. The system as claimed in any one of claims 10-13, **characterized** by

20 two or more payload units (PU) of a predetermined length in each lower level PDU with two or more payload units of a predetermined length for carrying said segmented higher layer data units (SDU), the payload unit being the smallest unit in a retransmission protocol employed,

 a segmentation indicator field (LI) in the beginning of one or more of the payload units in the lower level PDU, if required,

25 at least one indicator (D) in the header of the lower layer PDU for indicating which one or ones, if any, of the payload units (PU) contain the segmentation length information (LI).

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Fig. 1

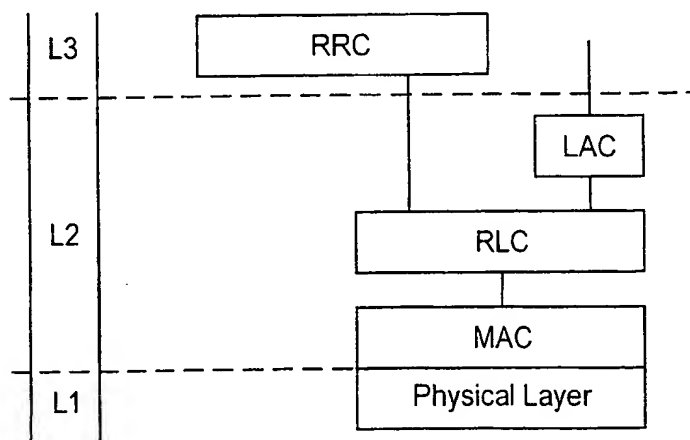
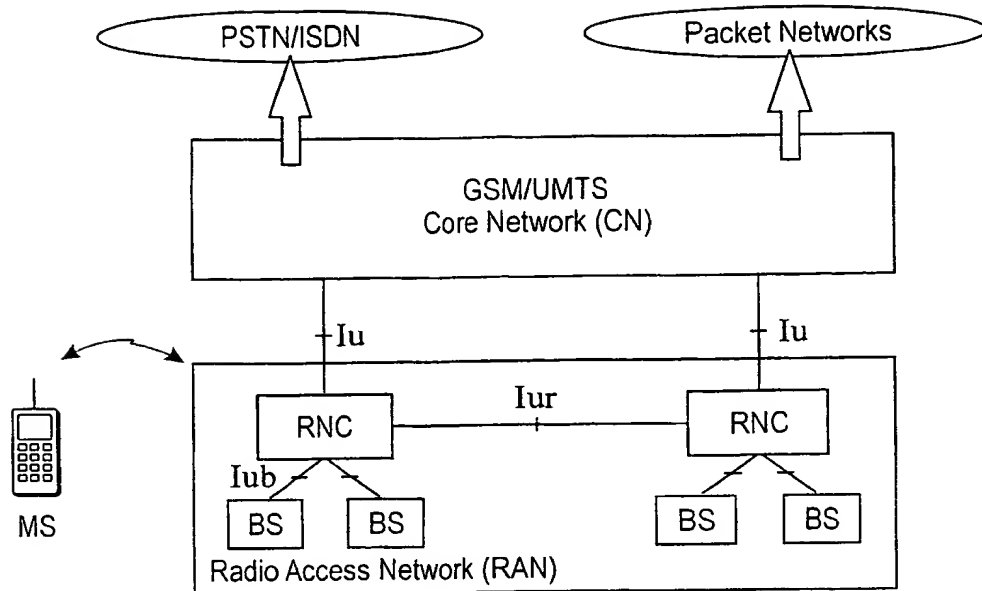
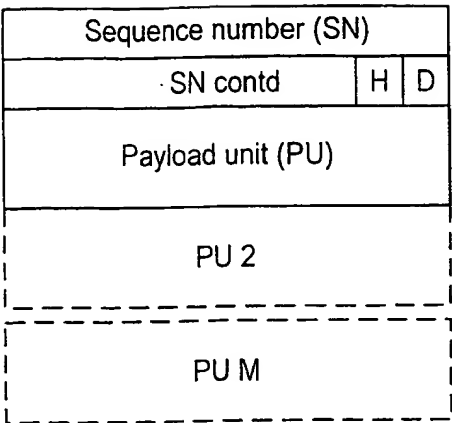


Fig. 2

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Octet 1
Octet 2
Octet 3
Octet N
Octet N-1
Octet 2(N-2)+2
Octet (M-1)(N-2)+3
Octet M(N-2)+2

Fig. 3

Fig. 4A

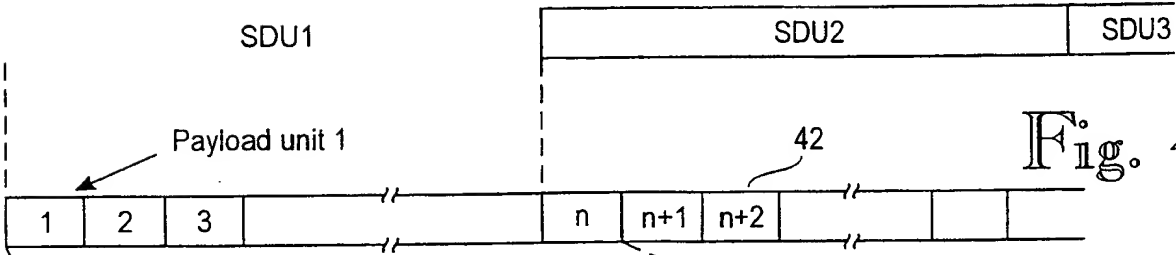


Fig. 4B

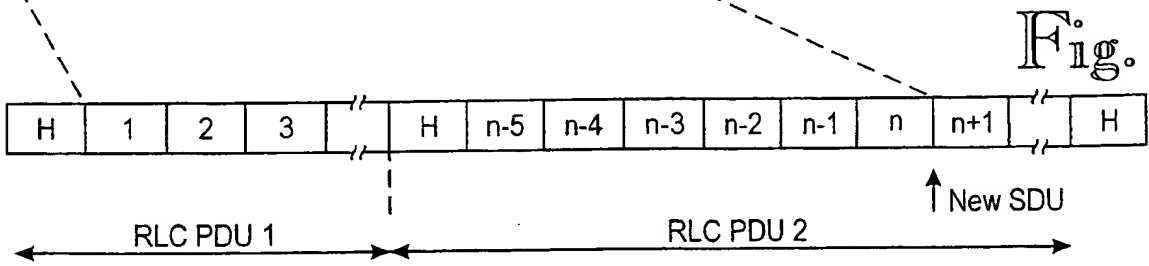


Fig. 4C

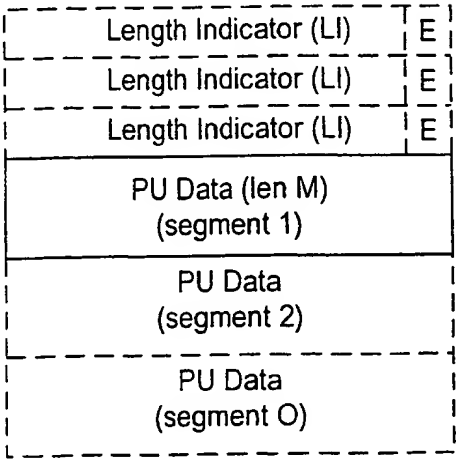


Fig. 5

INTERNATIONAL SEARCH REPORT

1

International application No.
PCT/FI 99/00821

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04L 12/56, H04L 29/08, H04Q 11/04, H04Q 7/22
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04L, H04Q, H04J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	WO 9738550 A1 (TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)), 16 October 1997 (16.10.97), page 10, line 22 - page 13, line 23, figures 7A,7B,7C,8, claims 1-45	1,8,10
A	--	2-7,9,11-14

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search

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Name and mailing address of the ISA/
Swedish Patent Office
Box 5055, S-102 42 STOCKHOLM
Facsimile No. +46 8 666 02 86

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Authorized officer

Erik Johannesson/CL
Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 99/00821

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	EP 0786919 A1 (INTERNATIONAL BUSINESS MACHINES CORPORATION), 30 July 1997 (30.07.97), claims 1-13 --	1-14
A	US 5333135 A (JAMES W. WENDORF), 26 July 1994 (26.07.94), column 4, line 24 - column 5, line 6, figure 2 --	1-14
A	US 5737332 A (RICHARD J. CORRIGAN ET AL), 7 April 1998 (07.04.98), column 2, line 36 - line 53, figure 2, claims 1-11 -- -----	1-14

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Information on patent family members

02/12/99

International application No.
PCT/FI 99/00821

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				GB 9720589 D	00/00/00
				IL 119892 D	00/00/00
				WO 9728627 A	07/08/97